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Biomedical Engineering

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Protocol Soft Lithography

This is a soft lithography protocol for the production of PDMS microfluidic devices. It has been composed with the use of scientific resources and improved by trial and error during the experiments.

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1 PDMS preparation

- Weigh 60 grams of PDMS base and 6grams of curing agent (10:1 ratio) and mix it well using a plastic mix stick (minimal 5 minutes vigorously mixing).
- Put the mixture in a vacuum desiccator. Release the vacuum periodically to prevent foam from spilling out.

2 PDMS deposition

- Clean the master mold with pressurized nitrogen gas.
- Put the master mold back in the petri dish.
- Pour the PDMS into the petri dish, containing the master mold, slowly to avoid creating air bubbles. Continue until the mold is covered with PDMS.
- Put the petri dish in a vacuum desiccator to get rid of the air bubbles, or blow the air bubbles off the wafer to the sides of the petri dish using pressurized nitrogen gas. Use low pressure to prevent more bubbles.

3 Baking

- Place the petri dish in the oven at 80°C for 1 hour to cure the PDMS.

4 Glass binding

- Pre-heat the hotplate to 140°C.
- After baking, remove the PDMS layer from the master mold.
- Use a scalpel to cut out each single device.
- Place each device on a punching mat and punch each of the inlet holes in the device with a 1 mm punch.
- Place the PDMS, feature-side down, onto a piece of packing tape to prevent dust from soiling the surface.
- For each device, clean a glass slide in the following order with isopropanol, acetone, MilliQ and blow dry with pressurized nitrogen.
- Dehydrate the glass slides on the hotplate at 140°C for 5 minutes.
- Connect the oxygen gas supply to the Plasma Asher.
- Set the following oxygen plasma protocol:
 - RF power: 50 W
 - Ashing time: 30 seconds
 - Vent time: 60 seconds
 - Venting value: unrestricted
 - 0.9 Mbar
- Clean a single glass slide with pressurized nitrogen and place it in the Plasma Asher.

- Remove the tape from the PDMS and place it with the feature side up next to the glass slide inside the Plasma Asher.
- Start the oxygen Plasma Asher.
- When finished, pick up the device and the glass slide and place the device onto the glass slide. The feature side of the device should be placed on the feature side of the glass.
- Gently tap on the device. Do not press the device onto the glass because this may result into closure of the channels.
- Place the glass slide into the oven at 140°C for 1 hour.
- Repeat these steps until you finish all the devices. Then store the devices in a petri dish.

5 Aquapel

- Make an aquapel solution in argon by first filling a 50 mL falcon tube with argon. Then put an aquapel capsule inside the falcon tube and break it by smashing it on a hard surface. **(NOTE: the aquapel is not allowed to react with air or water)**
- Fill a plastic syringe first with argon, then with aquapel.
- Inject the aquapel solution through the device with a flow speed of 10 $\mu\text{L}/\text{min}$.
- Clean the channels with pressurized nitrogen gas. Each inlet/outlet for approximately 8 seconds.
- Check under the microscope if aquapel is still present. If so, repeat the steps above.
- After all aquapel is cleared, bake the PDMS devices for 1½ hours at 60°C.

6 References

NanoFab (2004). NanoFab's Quick Glance at PDMS Micromolding. Retrieved from:
<http://www.nanofab.ualberta.ca/wp-content/uploads/2009/03/pdmssilanesop.pdf>